

CLAIMS

1. In the fabrication of liquid crystal displays (LCDs), a method for forming silicon films with a controlled amount of trace impurities, the method comprising:

5 forming a target including silicon and a first concentration of a first impurity;
supplying a substrate; and
sputter depositing a film of silicon on the substrate including a second concentration of the first impurity.

10

2. The method of claim 1 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first impurity selected from the group including transition metals, phosphorous, and germanium.

15

3. The method of claim 2 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target including a nickel first impurity.

20

4. The method of claim 3 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first concentration of nickel in the range of 0.01 to 0.5 percentage by atomic weight (at %); and,

25 wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity

includes depositing a silicon film including a second concentration of nickel in the range of 0.01 to 0.5 at %.

5. The method of claim 4 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first concentration of nickel in the range of 0.05 to 0.2 percentage by atomic weight (at %); and,

10 wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes depositing a silicon film including a second concentration of nickel in the range of 0.01 to 0.5 at %.

6. The method of claim 4 wherein forming a target including silicon and a first concentration of a nickel includes forming the target with an additional third concentration of phosphorous less than 5×10^{17} atomic weight per cubic centimeter (at/cm³); and,

15 wherein sputter depositing a film of silicon on the substrate including a second concentration of nickel includes depositing a silicon film with an additional fourth concentration of phosphorous sufficient to create a first Vth shift in the silicon film.

7. The method of claim 1 wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes sputter depositing using a process selected from the group including pulsed and non-pulsed direct current (DC) sputtering.

8. The method of claim 2 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first concentration of germanium in the range 5 of 5 to 30 at %; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes depositing a silicon film including a second concentration of germanium in the range of 5 to 30 at %.

10

9. The method of claim 8 wherein forming a target including silicon and a first concentration of a germanium includes forming the target with an additional third concentration of phosphorous less than 5×10^{17} atomic weight per cubic centimeter 15 (at/cm³); and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of germanium includes depositing a silicon film with an additional fourth concentration of phosphorous sufficient to create a first Vth shift in the silicon film.

20

10. The method of claim 3 further comprising:
annealing the silicon film including the first impurity of nickel to form a silicide; and,
annealing the silicon film with the nickel silicide to 25 crystallize the silicon film.

PROSECUTION CASE FILE

11. The method of claim 1 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target of single-crystal silicon; and,

5 wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes forming a film of amorphous silicon.

12. In the fabrication of liquid crystal displays (LCDs), a method for depositing silicon films with trace impurities, the method 10 comprising:

supplying a substrate; and
sputter depositing silicon and a controlled amount of a first impurity on the substrate.

15 13. The method of claim 12 further comprising:
forming a target of single-crystal silicon including a first concentration of the first impurity.

14. The method of claim 12 further comprising:
20 following the sputter depositing, forming an amorphous silicon film including a second concentration of the first impurity overlying the substrate.

15. The method of claim 13 wherein forming a target of 25 single-crystal silicon including a first concentration of the first impurity includes forming a target with a first impurity selected from

DEGEEES - DEGEEA

the group including transition metals, phosphorous, and germanium.

16. The method of claim 15 wherein forming a target of
5 single-crystal silicon including a first concentration of the first
impurity includes forming a target including a nickel first impurity.

17. The method of claim 16 wherein forming a target of
single-crystal silicon including a first concentration of the first
10 impurity includes forming a target with a first concentration of nickel
in the range of 0.01 to 0.5 percentage by atomic weight (at %); and,
wherein forming an amorphous silicon film including a
second concentration of the first impurity includes forming a silicon
film including a second concentration of nickel in the range of 0.01 to
15 0.5 at %.

18. The method of claim 17 wherein forming a target of
single-crystal silicon including a first concentration of the first
impurity includes forming a target with a first concentration of nickel
20 in the range of 0.05 to 0.2 percentage by atomic weight (at %); and,
wherein forming an amorphous silicon film including a
second concentration of the first impurity includes forming a silicon
film including a second concentration of nickel in the range of 0.01 to
0.5 at %.

19. The method of claim 17 wherein forming a target of single-crystal silicon including a first concentration of nickel includes forming a target with an additional third concentration of phosphorous less than 5×10^{17} atomic weight per cubic centimeter 5 (at/cm³); and,

wherein forming an amorphous silicon film including a second concentration of nickel includes forming a silicon film with an additional fourth concentration of phosphorous sufficient to create a first Vth shift in the silicon film.

10

20. The method of claim 12 wherein sputter depositing silicon and a controlled amount of a first impurity on the substrate includes sputter depositing using a process selected from the group including pulsed and non-pulsed direct current (DC) sputtering.

15

21. The method of claim 15 wherein forming a target of single-crystal silicon including a first concentration of the first impurity includes forming a target with a first concentration of germanium in the range of 5 to 30 at %; and,

20

wherein forming an amorphous silicon film including a second concentration of the first impurity includes forming a silicon film including a second concentration of germanium in the range of 5 to 30 at %.

25

22. The method of claim 21 wherein forming a target of single-crystal silicon including a first concentration of germanium

includes forming a target with an additional third concentration of phosphorous less than 5×10^{17} atomic weight per cubic centimeter (at/cm³); and,

wherein forming an amorphous silicon film including a
5 second concentration of germanium includes forming a silicon film
with an additional fourth concentration of phosphorous sufficient to
create a first Vth shift in the silicon film.

23. The method of claim 16 further comprising:
10 annealing the silicon film including the nickel first
impurity to form a nickel silicide; and,
annealing the silicon film with the nickel silicide to
crystallize the silicon film.